

WHAT IS CLAIMED:

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1. An isolated nucleic acid encoding an evening primrose $\Delta 6$ -desaturase.

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2. The isolated nucleic acid of Claim 1 comprising at least one of the nucleotide sequence of SEQ ID NO: 26 or nucleotides 49 to 1401 of SEQ ID NO: 26.

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3. ✓ An isolated nucleic acid that codes for the amino acid sequence of SEQ ID NO: 27.

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4. A vector comprising the nucleic acid of any one Claims 1- 3.

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5. An expression vector comprising the isolated nucleic acid of any one of Claims 1-3 operably linked to a promoter which effects expression of the gene product of said isolated nucleic acid.

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6. An expression vector comprising the isolated nucleic acid of any one of Claims 1-3 operably linked to a promoter and a termination signal capable of effecting expression of the gene product of said isolated nucleic acid.

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7. The expression vector of Claim 5 wherein said promoter is a $\Delta 6$ - desaturase promoter, an Anabaena

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carboxylase promoter, a helianthinin promoter, a
1 glycinin in promoter, a napin promoter, the 35S
promoter from CaMV, a helianthinin tissue-specific
promoter, an oleosin seed-specific promoter, or an
albumin seed-specific promoter.

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8. The expression vector of Claim 6 wherein
said promoter is a $\Delta 6$ -desaturase promoter, an Anabaena
carboxylase promoter, a helianthinin promoter, a
glycinin promoter, a napin promoter, the 35S promoter
10 from CaMV, a helianthinin tissue-specific promoter, an
oleosin seed-specific promoter, or an albumin seed-
specific promoter.

9. An expression vector comprising the
15 isolated nucleic acid of any one of Claims 1-3 operably
linked to a constitutive promoter.

10. An expression vector comprising the
isolated nucleic acid of any one of Claims 1-3 operably
20 linked to a tissue specific promoter.

11. The expression vector of Claim 6 wherein
said termination signal is a Synechocystis termination
signal, a nopaline synthase termination signal, or a
25 ^{seed-specific} termination signal.

12. A cell comprising the vector of Claim 4.

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13. A cell comprising the vector of Claim 5.
14. A cell comprising the vector of Claim 6.

15. The cell of Claim 12 wherein said cell is an animal cell, a bacterial cell, a plant cell or a fungal cell.

16. The cell of Claim 13 wherein said cell is an animal cell, a bacterial cell, a plant cell or a fungal cell.

17. The cell of Claim 14 wherein said cell is an animal cell, a bacterial cell, a plant cell or a fungal cell.

18. A transgenic bacterium or plant comprising the isolated nucleic acid of any one of Claims 1-3.

19. A transgenic bacterium or plant comprising the vector of Claim 4.

20. A transgenic bacterium or plant comprising the vector of Claim 5.

21. A transgenic bacterium or plant comprising the vector of Claim 6.

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1 has been regenerated from the plant cell of Claim 15.

²⁰ 23. The plant of Claim ¹⁹ 22 wherein said plant is a sunflower, soybean, maize, tobacco, peanut, carrot or oil seed rape plant.

²¹ 24. A method of producing a plant with increased gamma linolenic acid (GLA) content which comprises:
10 (a) transforming a plant cell with the isolated nucleic acid of any one of Claims 1-3; and
(b) regenerating a plant with increased GLA content from said plant cell.

²² 25. A method of producing a plant with increased gamma linolenic acid (GLA) content which comprises:
15 (a) transforming a plant cell with the vector of Claim 4; and
20 (b) regenerating a plant with increased GLA content from said plant cell.

²³ 26. A method of producing a plant with increased gamma linolenic acid (GLA) content which comprises:
25 (a) transforming a plant cell with the vector of Claim 5; and

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(b) regenerating a plant with increased GLA
1 content from said plant cell.

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27. A method of producing a plant with
increased gamma linolenic acid (GLA) content which
5 comprises:

(a) transforming a plant cell with the vector
of Claim 6; and

(b) regenerating a plant with increased GLA
content from said plant cell.

10 ²⁵ 28. The method of Claim ²¹ 24 wherein said
plant is a sunflower, soybean, maize, tobacco, peanut,
carrot or oil seed rape plant.

15 ²⁶ 29. The method of Claim ²² 25 wherein said
plant is a sunflower, soybean, maize, tobacco, peanut,
carrot or oil seed rape plant.

20 ²⁷ 30. The method of Claim ²³ 26 wherein said
plant is a sunflower, soybean, maize, tobacco, peanut,
carrot or oil seed rape plant.

²⁸ 31. The method of Claim ²⁴ 27 wherein said
plant is a sunflower, soybean, maize, tobacco, peanut,
25 carrot or oil seed rape plant.

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32. A method of inducing or increasing
production of gamma linolenic acid (GLA) in an organism

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lacking in or producing low levels of GLA which
1 comprises transforming said organism with the isolated
nucleic acid of any one of Claims 1-3.

33. A method of inducing or increasing
5 production of gamma linolenic acid (GLA) in an organism
deficient or lacking in or producing low levels of GLA
which comprises transforming said organism with the
vector of Claim 4.

10 34. A method of inducing or increasing
production of gamma linolenic acid (GLA) in an organism
deficient or lacking in or producing low levels of GLA
which comprises transforming said organism with the
vector of Claim 5.

15 35. A method of inducing or increasing
production of gamma linolenic acid (GLA) in an organism
deficient or lacking in or producing low levels of GLA
which comprises transforming said organism with the
20 vector of Claim 6.

36. A method of inducing production of gamma
linolenic acid (GLA) in an organism deficient or
lacking in or producing low levels of GLA and linoleic
25 acid (LA) which comprises transforming said organism
with an isolated nucleic acid encoding bacterial $\Delta 6$ -
desaturase and an isolated nucleic acid encoding $\Delta 12$ -
desaturase.

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37. A method of inducing production of gamma
1 linolenic acid (GLA) in an organism deficient or
lacking in or producing low levels of GLA and linoleic
acid (LA) which comprises transforming said organism
with at least one expression vector comprising an
5 isolated nucleic acid encoding evening primrose $\Delta 6$ -
desaturase and an isolated nucleic acid encoding $\Delta 12$ -
desaturase.

38. The method of inducing production of
10 octadecatetraenoic acid in at least one of a plant
deficient or lacking in or producing low levels of
octadecatetraenoic acid, a bacterium which produces α -
linolenic acid, or a bacterium which exhibits a $\Delta 15$ -
desaturase activity on a GLA substrate which comprises
15 transforming said plant or bacterium with any one of
Claims 1-3.

39. A method of inducing production of
octadecatetraenoic acid in at least one of a plant
20 deficient or lacking in or producing low levels of
octadecatetraenoic acid, a bacterium which produces α -
linolenic acid, or a bacterium which exhibits a $\Delta 15$ -
desaturase activity on a GLA substrate which comprises
transforming said plant or bacterium with the vector of
25 Claim 4.

40. A method of inducing production of
octadecatetraenoic acid in at least one of a plant

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deficient or lacking in or producing low levels of
1 octadecatetraenoic acid, a bacterium which produces α -
linolenic acid, or a bacterium which exhibits a $\Delta 15$ -
desaturase activity on a GLA substrate which comprises
transforming said plant or bacterium with the vector of
5 Claim 5.

41. A method of inducing production of
octadecatetraenoic acid in at least one of a plant
deficient or lacking in or producing low levels of
10 octadecatetraenoic acid, a bacterium which produces α -
linolenic acid, or a bacterium which exhibits a $\Delta 15$ -
desaturase activity on a GLA substrate which comprises
transforming said plant or bacterium with the vector of
Claim 6.

42. A method of inducing production of
octadecatetraenoic acid in at least one of a plant
deficient or lacking in or producing low levels of
octadecatetraenoic acid, a bacterium which produces α -
20 linolenic acid, or a bacterium which exhibits a $\Delta 15$ -
desaturase activity on a GLA substrate which comprises
transforming said plant or bacterium with the vector of
Claim 7.

43. The method of Claim 40 wherein said
25 plant is a sunflower, soybean, maize, tobacco, peanut,
carrot or oil seed rape plant.

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44. The method of Claim 41 wherein said
1 plant is a sunflower, soybean, maize, tobacco, peanut,
carrot or oil seed rape plant.

45. The method of Claim 42 wherein said
5 plant is a sunflower, soybean, maize, tobacco, peanut,
carrot or oil seed rape plant.

46. The method of Claim 43 wherein said
plant is a sunflower, soybean, maize, tobacco, peanut,
10 carrot or oil seed rape plant.

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